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Lehrs

The Fourth Article of a Series on Modern Glass Factory Equipment

By W. S. MAYERS*

Of the various industries which require operation upon a large scale the glass industry lags far behind in the matter of literature dealing with practical methods of manufacture and the equipment used, and only in recent years has there been any notable progress in this respect. Volumes have been written relating to the manufacture of iron, steel, chemicals, and the products of coal, oil, clay and a host of others, and the equipment used in the production of these materials has been ably and generously discussed in technical books, trade journals and other publications.

Possibly one reason for the dearth of literature upon the art of commercial glass making is that the industry, while one of the oldest, has just "growed," and that no epoch making inventions or discoveries in times past have given it a boost.

Practically all articles made of glass must be annealed after being formed in the molds. Reference to the bibliography of annealing discloses that numerous books and papers have been written upon this particular subject, and that more or less precise data are given including formulae, tables, temperature and time graphic curves, etc., deduced generally from experiments and laboratory tests.

Discussions of these refinements in the process of annealing are important in the manufacture of glass for optical instruments and a few other products made in comparatively small quantities, but they are almost of no value to the manufacturer of the enormous quantities of the commercial grades.

The process of annealing optical and the lower grades of glass is the same but fortunately the ultra refinements required in annealing the former product are not necessary in the production of serviceable and marketable tumblers, bottles, window glass and the like. If nearly perfect annealing were necessary, or even desirable, for these it would be utterly impracticable to obtain it with the most improved lehrs for quantity production as developed up to this time.

A general inspection of the older lehr installations throughout the country can but incite wonder as to how a great many of them can accomplish annealing of even a passable grade, and no equipment in the glass factory offers a more fertile field for improvement.

An inexcusable waste of fuel is encountered in practically all of the existing lehr installations, and there are cases where the lehr fuel consumption is equal to or even greater than that of the furnaces whose products they receive.

On account of the small combustion chambers and restricted passages for the heated gases, combustion in present day lehrs is in many cases low in efficiency, especially in the muffle type using producer gas as fuel, in which case large volumes of non-combustible gases must pass through the tortuous flues to the chimney.

In recent years considerable advance has been made in lehr design and construction, both in quality of annealing and in fuel economy, but the art is yet far from being in a state of satisfactory development especially in the matter of fuel economy.

Types of Lehrs

From twenty to thirty years ago a considerable amount of annealing was done in "kilns," these consisting of large chambers lined with fire brick with provisions for periodical heating and for depositing and removing the ware by hand. These chambers, after receiving their deposit of ware, were heated to the annealing temperature of from 800 to 1,100 degrees F. and then allowed to cool gradually.

The conditions for good annealing in these chambers were very good,—better than in most of our continuous lehrs, but the time required and their small capacities ruled them out for large productions, and their use today is confined to a few special cases where a higher grade of annealing is required.

Following the so-called kilns there came the loose-pan hand operated continuous lehrs and they are still in use in many of the older plants. From these there was developed the prototype of the present day fixed-pan endless conveyor which is well adapted for handling large outputs.

In the continuous lehr, where natural gas is obtainable, the open type was much used, and still is, but it is being

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rapidly superseded by the closed or muffle type. In the open lehr the combustion and mixing ports are invariably below the pans and the hot gases are discharged directly into the chamber containing the ware, from which the gases pass in diminishing volumes through a series of openings into an overhead duct, commonly called the "squirrel tail," and from thence to the chimney.

The use of producer gas in the open lehr is prohibited on account of sulphuring or tarnishing the ware by direct contact with the waste gases, and this condition called for the next step in lehr design,—the muffled lehr.

As the walls of the muffles must be made of a refractory material, which is usually fire clay having a rather low conductivity, and as the heat must pass through the walls by conduction and then to the ware by radiation, the heat utilization in the muffle lehr is necessarily inferior to that in the open type. The muffle walls are made thin to favor heat conduction, yet not thin enough to cause premature destruction by the burning gas. Materials other than fire clay are being used, such as compositions with carborundum as a base, and cast iron. While having a decided superiority over other refractories in the matter of heat conduction cast iron is very apt to cause a good deal of trouble on account of its tendency to warp under the action of the heat, and experience seems to indicate that its use for muffles is not to be recommended.

Lehr Design

In the ideal lehr the receiving end is the hottest, with temperatures ranging from about 800 to 1,100 degrees F., according to the composition and weight of the pieces of ware, with gradual diminution of temperature from this point to the discharge end where the ware must be cool enough to be handled.

In most of the older designs and in some of the newer ones the tops of the heating chambers are built in transverse arch form with the highest points from 24 to 36 inches above the pans. This design is manifestly incorrect and should give way to the flat top design built only a few inches higher than the tops of the highest ware which is to pass through the lehr.

The plan dimensions of the chamber depend upon the capacity which the lehr will be called upon to take care of, and upon the heating and cooling rate. A wide and short lehr may have the same capacity as a long and narrow one, and there are certain limitations to either design. In widths much above 10 feet the sustaining of the fire box top becomes difficult mechanically, while the narrow elongated type may occupy an unjustifiable amount of floor space.

In order to minimize the floor space required some attempts have been made to design lehrs with the conveyors in vertical runs. This design involves at least two serious drawbacks,—the first being that carrying-in, either manual or automatic, is difficult, and second, that proper temperature gradations are very difficult to maintain.

In any design it is important that the heating section and a part of the cooling section be made and kept in as nearly a closed chamber as practicable, as this feature means a decided saving in fuel and a much more controllable temperature.

A common fault with most lehrs of the muffled type is the sudden drop in the temperature gradation at the junction between the fire box and cooling sections. The heat in the last riser flue in which combustion takes place is always much more intense than in the next one to it which conveys the waste gases, and if the waste gas flues are not in heating relation to the cooling section the sudden drop in temperature is still more marked.

A comparatively recent departure in lehr design is found in the electrically heated type and some very good results have been obtained with this type in high grade glass. Electric heating has one point of superiority over all other methods of heating,—that of almost perfect temperature control. Another thing in its favor is the entire absence of fumes or deleterious gases in the heating chamber.

The manufacturer of commercial glass products, however, will do well if he decides that there will be no electric heating installations in his factory, and sufficient reason for this decision is found in the extreme inefficiency of this method of heating. In the first place the best steam engines and turbines utilize in actual practice not more, and generally less than 25 per cent of the thermal value in the steam which drives them. The boiler under favorable conditions is from 60 to 80 per cent efficient and account must also be taken of electric generator and line losses, which with the losses in the element of the electric heater, bring the over-all thermal efficiency down to considerably less than 10 per cent.

The thermal efficiency of the best designed gas heated lehr is comparable with that of the boiler and the other losses above named being absent, the gas heated lehr requires only from one fourth to one eighth of the amount of fuel consumption required by the electric lehr to produce the same temperature.

Lehr design is still in a transitory stage and it is not uncommon to find from three to five different types of lehrs installed in the same factory where one good design would fulfill all the conditions. The industry deserves something better than this and surely a competent research and standardizing committee could render important service along this line.

Lehr Operation

Many experiments have been made with the view of ascertaining the temperature at which complete relaxation of the internal stresses in glass ware takes place, this being affected to some extent by the chemical composition and the weight of each article. This is the most important factor in the process of annealing as the temperature range between the allowable maximum above this point and the minimum below it is quite narrow; if overheated the ware becomes plastic and deformation results, while if underheated complete stress relaxation does not take place.

Second in importance is the cooling stage, the time element having a distinct bearing upon both the heating and cooling.

The time taken for heating and cooling ranges from 4 to 8 hours in the existing lehr installations depending upon the size, weight and quality of the product,—the larger and heavier the ware, the more time required. At the annealing temperature the glass approaches the plastic state and a comparatively small reduction in temperature causes it to assume the rigid or elastic state in which the molecular structure is more or less fixed. While some stress relaxation undoubtedly

takes place after the elastic state is reached, repeated experiments have shown that this is slight enough to be unimportant in the lower grades of glass and that when a temperature reduction to between 400 and 500 degrees F. is reached cooling may take place rapidly. Recent experiments have demonstrated beyond question that soda ash lime pressed tumblers may be cooled by air jets in the surprisingly short space of less than an hour, after which they withstand the same rigid factory tests given to the ware from the 4 or 5 hour lehrs in common use. These experiments have been made repeatedly, not in a laboratory, but upon a commercial scale, handling the continuous output of from 30 to 40 pieces of machine pressed ware per minute. If pressed ware has been allowed to cool considerably before reaching the lehr the heating period will ordinarily have to be lengthened to avoid breakage and to insure uniformity.

Thin blown ware is more quickly and easily annealed than heavy pressed ware and a new type of time and fuel saving lehr for blown ware offers an attractive field for lehr designers.

Temperature Control

There are still many factory foremen who rely upon simple observation in determining lehr and even furnace temperatures, but they are gradually being converted into the use of pyrometers for this purpose. Pyrometers may or may not show the correct temperatures in the lehr heating chamber, and perhaps more often they do not correctly show them. In lehrs with high fire box arches the thermo couple junctions are often placed 18 inches or more above the ware, in which case they certainly indicate or record a temperature much higher than that immediately surrounding the ware. It matters not so much just what temperature the pyrometer indicates after the proper annealing temperature has been secured, but it does matter as to whether all the thermo couples in a battery of lehrs and connected to the same indicator are the same height above the ware, and it is important to hold the temperature constant, as indicated by the pyrometer. A common source of error is the cold junction in the pyrometer lead wires, and attention to this point is fully as important in connection with lehrs as with furnaces.

Testing Ware

Polariscopes adopted for the purpose provide the most convenient means for showing internal stresses, or their absence, in the annealed ware. They do not, as a rule, show these stresses plainly unless they are quite pronounced, and are therefore not to be depended upon altogether where a high grade of annealing is required. A method often used for testing pressed tumblers and food containers consists in plunging these articles into boiling water and then quickly filling them with cold water. This is a severe test and any ware surviving such treatment is capable of having a long life in ordinary service. Repeated hot and cold water tests are apt to cause fracture in the best commercial glass obtainable and do not indicate insufficient annealing; in fact, one or more authorities upon the subject have observed that slight internal stresses add to the strength of the glass in resisting concussion.

The Manufacture and Properties of Oven Glass*

By R. F. BRENNER†

Glassware for baking purposes or oven glass is a comparatively recent invention, it being developed commercially during the past ten years. This consisted in the development of a glass which differs from ordinary glass, in that it will withstand sudden changes in temperature without breaking. The pioneer work of Winkelmann and Schott on the relation of chemical composition of a glass to its mechanical and thermal properties, done during the early nineties, laid the foundation for the present day oven glass. It is remarkable that such a long interval elapsed before its commercial development. With this work, which is given in Hovestadt's *Jena Glass*, it is possible for a chemist who is familiar with the fundamentals of glass technology to produce a glass which would be satisfactory for cooking purposes.

There are various kinds of material that have been used for baking dishes, metals, enamel coated metals, porcelain and earthenware. Metal is objectionable as it is liable to taste in the food product, is subject to corrosion and it presents an unsightly appearance after continued usage. Enameled ware in use chips and peels, porcelain is expensive and fragile, and earthenware is fragile and like porcelain, cracks without breaking and thus affords lodging places for dirt and bacteria.

Glass has been avoided on account of its generally being brittle and incapable of standing severe changes in temperature. Glass also has a relatively low heat conductivity but very little difference has been found in the time required to bake food in glass as compared with metal. On the other hand glass has the advantage of a very smooth surface, which is easily cleaned; the glass is non-absorbent; it is transparent or translucent and one can see the bottom and sides of the article baked as well as the top, and also the glass dishes are of neat appearance and can be served on the most artistic table.

The necessary properties required of a glass in order that it may be satisfactory as an oven glass, are:

(1) High thermal endurance, which is the power to withstand temperature changes.

(2) High stability, that is the power to resist chemical attack.

(3) Resistance to mechanical shock.

(4) Good workability, that is practicability from a manufacturing viewpoint.

The control of these properties, thermal endurance, stability, resistance to mechanical shock and workability are very necessary in the manufacture of oven glass and will be discussed in order.

The coefficient of thermal endurance is a measure of the power of a glass to withstand inequality of temperature and

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is expressed by Winkelmann and Schott by the formula

$$F = \frac{P}{aE}\sqrt{\frac{K}{SC}}$$

in which F equals Coefficient of thermal endurance
P " Tensile strength
a " Coefficient of linear expansion
E " Young's modulus of elasticity
K " Heat conductivity
S " Density
C " Specific heat

From this formula it can be seen that glass for baking purposes must possess a relatively high tensile strength and heat conductivity and a relatively low coefficient of expansion, modulus of elasticity, density and specific heat.

With the group of borosilicate glasses satisfactory for oven glass, it has been found that the tensile strength, expansion and modulus of elasticity show the greatest variation with change in chemical composition, while the heat conductivity, density and specific heat show only slight variation. Therefore in using this formula in the development of oven glasses, changes in chemical composition can be made in order to effect tensile strength, expansion or modulus of elasticity, knowing the changes in heat conductivity, density or specific heat will affect the thermal endurance only slightly.

The tensile strength of an oven glass must be high enough to allow the glass to withstand the strain produced by the expansion when temperature changes occur. A glass with a relatively high tensile strength can therefore have a higher coefficient of expansion than one of relatively low tensile strength. The tensile strength is dependent on the chemical composition and the following order of the oxides show their effect on tensile strength, those given first exerting a favorable influence on tenacity: ZnO, SiO_2, P_2O_5, B_2O_3, BaO, Al_2O_3, As_2O_3, PbO, Na_2O, K_2O. The position of CaO and MgO is doubtful and they have been left out.

The coefficient of expansion is the easiest property to control and the first tendency in producing oven glasses was to get the lowest expansion possible, but low expansion means a glass difficult to work in the factory so the present tendency is toward relatively higher expansion and toward lower modulus of elasticity and higher tensile strength to counteract it.

The various oxides affect expansion in the following order, those given first giving the lowest expansion: B_2O_3, MgO, SiO_2, ZnO, P_2O_5, As_2O_5, PbO, BaO, Al_2O_3, CaO, K_2O, Na_2O.

The modulus of elasticity should be relatively low, so that the glass will give under the slight strains produced by the expansion without breaking. It is also dependent on the chemical composition as the following list of oxides shows, they being given in the order of their favorable influence: MgO, As_2O_5, B_2O_3, SiO_2, BaO, CaO, K_2O, Na_2O, ZnO, Al_2O_3.

The stability of the glass, that is its power to resist chemical attack, must be very high, so that it can resist the juices of the food products cooked in it. Borosilicate glasses of low alkali and high silica content invariably have good stability, but the percentage of boric oxide must be kept within limits, as too high a percentage tends toward low stability. It is a known fact in the glass industry that alumina bestows durability on glass and resistance to corrosion by water, acids and alkalis and this holds true in oven glass.

The one big disadvantage of glass has always been its brittleness and therefore its low resistance to shock. In oven glass this property is of great importance as the persons who ordinarily use it, are accustomed to handling metal utensils in cooking and are not as careful with it as a trained chemist is with laboratory glassware. While oven glass is far from being unbreakable, it is much less brittle than ordinary glass and is a step toward an unbreakable glass, if such a glass is possible. To get resistance to mechanical shock the glass must have a high tensile strength, low modulus of elasticity and also high compressive strength. SiO_2, MgO, Al_2O_3, B_2O_3, are the oxides that exert a favorable influence on compressive strength, while Na_2O, PbO, CaO, and K_2O are unfavorable.

There is one other property that is of greatest importance to the glass manufacturer and one that must always be kept in mind when making up an oven glass batch, that of good workability. Good workability includes ease of melting and plaining of the glass; its corrosive action on pots or tank blocks; softness at working temperature to allow easy manipulation, and also ease of annealing. This property can only be determined by actual tests during the melting and subsequent working of the glass.

There are several types of commercial oven glass on the market and they show marked differences in chemical composition and properties.

The manufacture of oven glass is similar to the manufacture of ordinary glassware, except in most cases the temperatures required are higher. The batch, consisting of the necessary raw materials, is very thoroughly mixed, either by turning over several times by hand or in a mechanical batch mixer, which is the more efficient method. Cullet, which is waste crushed glass of the same composition, is then placed with the batch, and it is filled in a day tank or in a continuous tank or in pots in a pot furnace. The temperature required in melting is between 2,600 degrees F. and 3,000 degrees F., depending on the composition of the batch. Temperature control is very necessary in order to obtain good workable glass.

After the glass is melted and plained, it is worked into the desired shapes by pressing or blowing into moulds or in some cases the glass is shaped by skilled workmen with the use of hand tools.

The glass is then placed in the lehrs where it is thoroughly annealed. Temperature control of the lehrs is very necessary in the annealing process and the temperature-gradient, which is dependent upon the composition of the glass, is carefully controlled. The high thermal endurance of oven glass allows the manufacturer to depart from the ordinary annealing process if he wishes, especially when the lehrs are crowded. In this case the ware after pressing, is stacked on the factory floor and the cold ware is then placed in the hot lehr at any time. This necessitates a change in the temperature gradient.

After annealing, the ware is inspected for defects such as blisters, stones, cords, and is then packed for shipment.

The Making of Watch Crystals*

By W. H. HOLMES

At the outbreak of the war American watch manufacturers imported their watch crystals from Germany, France, Austria, Belgium and Switzerland. The shutting off of imports found the watch industry of the United States in a bad position. Millions of dollars invested in watch plants, watch-case concerns, and the watch trade in general; thousands of workers in the manufacturing and jobbing trade; all affected by the lack of a small piece of clear glass that costs at the most a few cents. There was nothing that could take its place and there were none being made outside of the countries mentioned. It was up to the American watch manufacturers to either make the necessary crystals themselves or else tie up their plants until imports were resumed.

As a consequence several attempts were made to manufacture them on a commercial scale. They were unsuccessful. At this period, the Waterbury Clock Company, probably one of the largest users of watch crystals in the world, decided that they could and would manufacture watch crystals.

It was vitally necessary that these small circles of clear colorless glass, accurate, highly polished and free from all blemishes, should be manufactured in quantities and at a reasonable price. The first Ingersoll watch carried a crystal made from a piece of common window glass, cut round and ground by hand. It is a far cry from that crystal to the fine, perfectly formed crystals that are used on high grade watches today. One might say that the latter are as finely finished as a lens. To make these crystals was the task the Waterbury Clock Company undertook.

With their own needs in view and backed by the hopes of the industry in general they started this new industry. Without previous experience in this line, and handicapped by a lack of skilled help or the necessary machines, the concern succeeded in placing the manufacture of watch crystals on a sound commercial footing. This concern is practically the only one in the United States that is making crystals. It is producing goods that are fully equal to the imported goods, and is supplying other watch and watch-case manufacturers in addition to its own enormous wants. The success of this particular plant has made the United States practically independent of foreign countries for watch crystals, so far as the manufacturing is concerned. During the war, in a period when experimenting and "learning how" was the order of the day in this new industry, they supplied some 50,000,000 crystals to the trade.

However, the accomplishment was not without its obstacles. It took the company several years, from a start where hand labor was employed almost exclusively for lack of machine designs, to the point where most of the various operations are performed by semi-automatic machines. The custom in foreign manufacture is, or was, to do many of the various operations by hand. American inventiveness has provided machines, designed as the infant industry developed, to take the place of this costly hand method.

GLASS BLOWING ROOM.
Furnace in Left Upper Corner is the Melting Furnace Directly in Front, a Glass Blower Is Seated on a Bench Forming a Globe from Which the Crystals Are Cut. Furnace on Right Is Where Pots Are Pre-Heated. A Rack for Holding the Blown Globes Is Shown on the Floor at the Right, Containing Several Globes.

CUTTING ROOM.
The Globes from Which the Crystals Are Cut Are Shown on the Center Cutting Table. The Globes Shown Are Split in Halves Previous to Cutting the Crystals.

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It might be here stated that another obstacle cropped up when the new industry was fairly under way. This was Japan. In 1915 Japanese exports to the United States in watch parts were around $96. This represents crystals. In 1918 they amounted to some $300,000; also practically all crystals. However, this class of crystals proved more or less unsatisfactory. The Japanese had not mastered the art of making clear, flawless crystals. They showed a tinge of straw color, and were unsuitable for the high grade watches.

During the early period of the struggle, the concern expended over a half million dollars in experimenting and learning how. Today they have a daily capacity of 800 gross of crystals, of all sizes and designs used in the trade.

AT THE LEFT — CUTTING OUT THE CRYSTALS FROM THE GLOBE SECTIONS.

AT THE RIGHT— SECTION OF A HALF GLOBE, SHOWING CRYSTALS CUT THEREFROM.

This is despite the fact that it takes one and one-fourth crystals processed to produce one finished article, due to the rigid inspection and the breakage during the various operations. In the beginning, the proportion was two and six-tenths crystals processed to one finished and passed.

It must be borne in mind that watch crystals as applied to high grade watches must have a flawless finish, be perfectly clear and colorless, and be gauged to thickness and diameter. As in any working of glass, many complications occur in its melting, blowing and forming.

The base of the glass used is silicate rock ground to about the fineness of sea sand. This silicate is secured from Pennsylvania. To this are added lead, alkalies and various oxidizing agents that experience has proven necessary. This compound is used with an equal amount of cullet, or glass that has been previously compounded and melted. This latter is the remains of previous batches that have been already blown.

The compound that forms the glass is melted in huge covered pots formed of clay. The pots weigh approximately 3,000 pounds. They hold a batch of about 2,400 pounds at a time. The pots are made from imported clay and are received unbaked. The crucible is preheated five or six days in a temperature of about 1,800 degrees. This is to bring it gradually up to its working temperature. It is then transferred to another furnace where the material is added from which the glass is formed. It takes about 18 hours at an even temperature of 2,400 degrees to melt the compound. The glass is ready then to be blown. This pot will last from one to several weeks and then must be discarded. It all depends on how the pot withstands the intense heat.

The molten glass is gathered on the end of a blow pipe and blown free-hand. No molds are used, as contact with the mold would be liable to cause imperfections in the globes formed. The blower blows by mouth to start the sphere he desires to form. The pipe is then laid on a horizontal rail and the mouth end shoved into the opening of an air line. The blower then sits on a small bench, his foot on a pedal that controls the air, and rolls the pipe back and forth on the rail until an almost perfect sphere is formed. They are blown to ten and twelve inch diameter.

The resulting product is a globe of clear colorless glass of the thickness necessary for the crystals to be formed from it. This thickness, however, is not strictly uniform. The globes run somewhat thicker at the end where attached to the pipe and thin at the further pole. The intermediate glass forms the crystals and also proves slightly variable. The globes are blown with a surface finish, highly polished from the heat, and if passed are free from bubbles, striae, lines, or discoloration. They look very much like a finished product, even in this first operation. The blower frees his pipe from the globe by running a pair of wet tongs around the neck, close to the pipe, and releasing it by a slight tap. The globes are then placed in a rack, set on the floor, to cool. The blower then repeats the operation until the quantity workable is taken from the pot.

One-half of the contents of the pot is used, and two pots are run off a day. The remainder of the material does not work up successfully and is discarded for the time being. This is done by ladling the melted glass into a huge iron caldron full of water. This cools the glass, which breaks up into fragments that range from the size of a walnut down to minute pieces. These fragments are ground up and form the cullet which enters into the formation of another batch, as previously described.

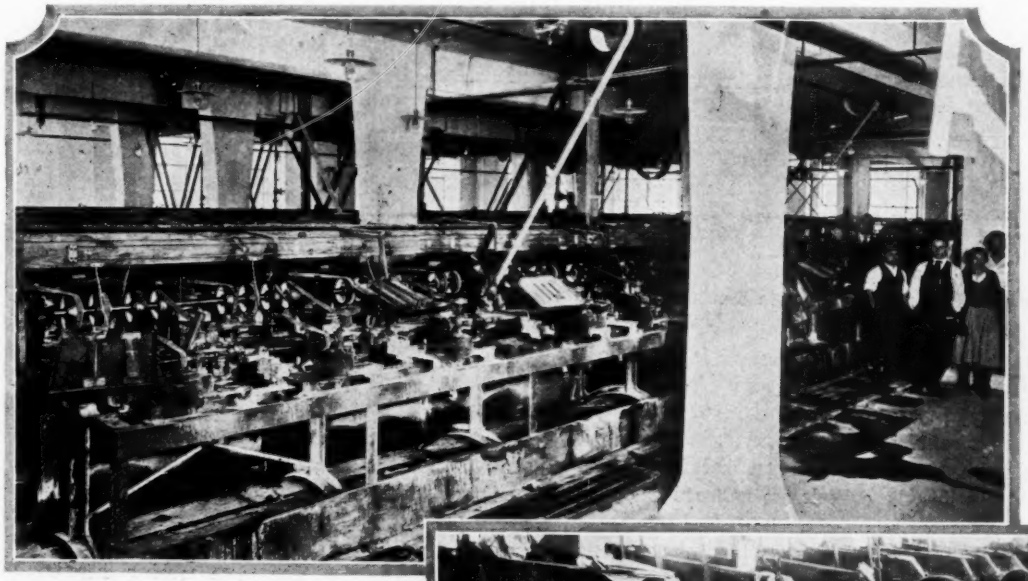
The globes now go to a cutting bench where they are split in two halves. This is done by inserting a curved glass cutter through the opening where the blow pipe was attached, and scoring a line about an inch long toward the opposite hole. A slight tap breaks the glass in line with the cut, and a further tapping around the surface of the globe divides it neatly. This latter operation is a knack that took a long time to master. Thousands of globes were shattered beyond use before the operator was enabled to do it efficiently.

It might here be further stated that the company was forced to train their help from the very beginning. Intelligent factory labor was taken in and painstakingly instructed. The force learned as the staff overcame obstacles and educated them to the knowledge and experience gained.

This lack of help also extended to the glass blowers. There are few free hand blowers in the country today, and those capable of blowing the quality glass suitable for watch crystals are rare. Mere glass blowing won't do. Watch crystal blowing is required.

After splitting, the halves go to a machine where the crystals are cut from these sections. The radius of these halves forms the curvature of the finished crystals in the lower priced watches. They are known as Miconcave, as contrasted to Empire, Lentilles, and Genevas, which classify the higher grades. The Lentille is a specially formed high grade crystal that is used on expensive watches. Genevas are a thinner model, Empires a medium grade.

The machine that does the cutting is a simple bench affair worked by hand. It consists of an upright pedestal and extended arm through the end of which drops a vertical bar.



CRYSTAL GRINDING MACHINES.

Miconcave Crystals, Which Are Crystals Cut from the Half Sections of the Blown Globes Without Further Forming Are Ground on This Type of Machine. The Grinding Brings Them to Correct Diameter and Forms the Bevel on the Edge.

GRINDING LENTILLE CRYSTALS.

Boxes at Left Show Method of Handling the Crystals.

At the bottom of this attachment is a horizontal bar holding a glass cutter at the end. This bar is adjustable. It can be arranged to scribe a small circle for wrist watch crystals, or extended to form the larger sizes.

The operator holds down with a slight pressure on the vertical bar and scores a circle with the cutter. This is repeated until the half globe, or portion of a half, is filled. A slight tap frees the blanks thus marked.

There is now a round crystal, fully polished on the surface, with approximately the diameter desired, and with the convex surface sought if to be used on low priced watches. These cut out crystals now pass along an inspection bench and are inspected for flaws before succeeding operations are performed. They are gauged for thickness by a dial gauge,

divided to read thousandths of an inch. The crystal is placed between the indicating plunger of the dial and an anvil below. The reading is somewhat on the principle of a micrometer caliper. The crystals are placed in several piles as they are gauged, which are later graded for various uses.

The next inspection is for perfect flatness of the edges. It is obvious that the blowing does not form a perfect sphere, nor the cutting out of the crystals work uniformly. The crystal is laid on a small square of glass and if it rocks it must be reheated and leveled in a press, which levels the edges. About 40 per cent prove accurate; the remainder must undergo the further treatment.

This flattening is done on a type of machine that is formed somewhat on the style of the cutting device. In this operation the crystals are placed in a small mold or die and placed in a muffle. All reheating is done in muffles as direct flames would discolor the glass. When properly heated the molds are removed and placed under a plunger or forcer worked by hand. This is pressed down on the crystal and levels the edges. The crystals are then annealed to prevent tension strains.

Another reheating and pressing operation is performed on the higher grade crystals. Crystals formed from the blown globe, as stated, are mostly for low priced watches and the globe curvature is satisfactory. The finer crystals are placed in molds as in the preceding operation and formed to the shape desired. In this the crystals are flattened on the surface, and in fact are also pressed inside out. This results in a crystal with a flat surface and a curve or bend at the edges. The product is a crystal that will fit into a watch, be free of the hands, and yet show a flat face. Trade demands may require them to be flat, slightly convex, or of any degree of curvature in use.

The next operation is grinding. All crystals must be ground and polished on the edges. This is done on semi-automatic machines. The abrasive used is either pumice stone or sandstone wheels. On the cheaper grades, or thicker crystals, the glass is placed between two centers or rubber tipped plungers, which are swung after the fashion of those on a bench lathe. These small lathes are mounted in series on a long machine base; one man taking charge of 20 machines. The crystal is held taut by spring pressure and is placed against a horizontal grinding wheel.

The action of the wheel, to which the edge of the crystal is held firmly by a tension arrangement, trues up the blank and grinds the edges on the necessary bevel. The ground bevel is formed by setting the centers which hold the crystal off on the angle desired. As soon as a crystal is ground to the proper diameter a small electric light over the machine goes out and an attachment throws the centers holding the crystal away from the wheel. The operator then takes out the finished work and replaces it with another glass to be ground.

Another form of grinding, performed on the finer grade crystals, is done on a machine somewhat on the lines of the one described above. But this machine uses a vertical wheel which travels back and forth across the edge of the crystals. The action is similar to a cylinder grinder. Two crystals, held back to back between two centers, are ground at once. This is possible on account of the edges being ground straight, and a thinner crystal being used. The grinding on this type is to bring them to the proper diameter. Four thousandths is allowed as variation either way from the fixed size.

From this machine the high grade crystals go to another grinding machine, which forms a curved edge to the glass. As previously stated, this type, Lentilles, Empires, and Genevas, are pressed with a band at the edges. This band breaks rather sharply from the pressing operation and the second grinding is to form a graceful curve which merges into the flat or convex surface of the crystal. This grinding is done by attaching the crystal to the end of a tube, to which it is held by suction, and allowing the crystal to drop gradually down over the face of the grinding wheel. The descending motion, in connection with the circular movement of the crystal, forms the desired curve.

After this curve is formed it leaves the crystal with sharp bottom edges and dull sides. The edges at present are dulled by holding them against a sandstone wheel and slowly turning the crystal in the hand as ground. Machines are in process of construction to do this operation semi-automatically. It is now necessary to polish the dulled glass. This is done on buffing wheels, using red rouge.

The lower priced grades must also have the sharp edges removed and the bevel polished. This is done on an ingenious machine which works practically automatically. A finger picks up the crystals from a stack and places them one by one between an upper and lower dial pin which is set on a dial plate. The plate revolves horizontally and contains several sets of pins. The crystal is held between the two pins by tension, and trues itself by a guide set beside the revolving dial plate. As the dial circles, the crystal first rubs against a strip of emery cloth, which dulls the edges, and then works against a horizontal wooden wheel, flushed with pumice stone and water, where it receives the necessary polishing.

After polishing, the crystals receive the final inspection. They are then either placed in stock, shipped to the various watch manufacturers, or utilized in the local watch plant.

At present the company is making crystals that range from the smallest wrist watch up to the largest timepiece. The manufacture of the crystals was simply for personal use at first, but today several large concerns are buying United States made crystals for their high grade watches. The jobbing trade, however, is mostly handling the imported goods. The American concern is in a position to meet the demands of this latter market and is gradually extending operations. About 500 hands are employed at present. This represents skilled help, fully trained for the work.

Regardless of the adeptness of the Japanese, and the renewal of large foreign imports, the work in the American watch crystal plant is being systematized and adapted to machine production. Every machine in the plant is an outgrowth of the experience and ideas of the executive staff. They are designed and manufactured at the company's machine shops. They are models of simplicity, efficiency and accuracy. They represent the reward of faith and perseverance over "It can't be done."

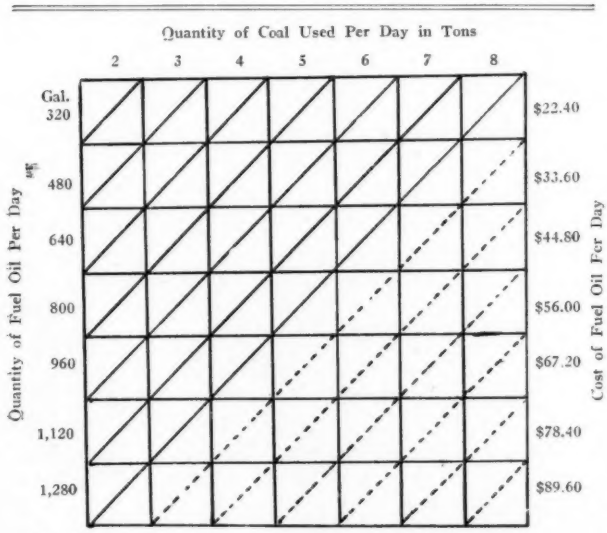
Operating Continuous Furnaces with Fuel Oil

By W. G. EDMONDS*

There are very few firms devoting their attention to the use of fuel oil, in comparison with the interest which is given to the use of natural or producer gas.

Some glass manufacturers have experimented with oil as a fuel without obtaining satisfactory results. There are reasons for these failures. Operators have frequently failed to consider the comparative cost of the installation of oil burners and of gas producers, and have not given the equipment and the burners the consideration which is required. In many cases pipe lines have been installed and the compressed air or steam (whichever was employed as an atomizer) attached to the burners, which in some cases were two pieces of pipe. It is not surprising that such an outfit would not give efficient or satisfactory service. The combustion being imperfect, the heat obtained was by no means the equivalent of that received from gas.

Systems for the burning of fuel oil have been developed which render this method of heating entirely satisfactory. The use of specially constructed burners and the elimination of the stuffing-box and packing have largely overcome the leakage nuisance and the clogging of the burner while in operation.



Cost of coal per day....	$16.00	$24.00	$32.00	$40.00	$48.00	$56.00	$64.00
Cost of labor per day	11.00	12.00	13.00	17.50	18.50	23.00	25.75
Total cost per day....	$27.00	$36.00	$45.00	$57.50	$66.50	$79.00	$89.75

COMPARATIVE COST OF COAL AND FUEL OIL

A comparison of the cost of operating a continuous glass melting furnace with ¾ inch gas coal and with 36/40 gravity fuel oil is shown by the chart, the figures being based on a price of $8.00 per ton for coal and 7 cents per gallon for fuel oil.

In compiling the chart, labor for the handling of coal and the operation of gas producers (with no charge for the boiler operations which are necessary for furnishing the steam used in operating the producers) is figured at $9.00 per day, with $1.00 per ton for the handling of coal up to the amount of 5 tons daily; from 5 tons to 7 tons daily the cost is figured at $12.50 per day and $1.00 per ton for handling of coal; for 7 to 8 tons daily the cost is figured at $16.00 per day, $1.00 per ton for handling the coal, and $1.75 extra costs involved where this quantity is used.

The chart shows the cost of coal at $8.00 a ton to be higher than fuel oil at the price of 7 cents per gallon. By installing burners with which a cheaper grade of oil can be used a further reduction can be made in cost.

The first item which should be given consideration when oil fuel is used, is the question of storage. The tanks should be located underground whenever possible. This is the safest method of storage. The oil is kept at the desired temperature, required to keep its free flowing condition, by means of steam heated coils. Exhaust steam can be used for this purpose. Some installations are equipped with a combination fuel oil pump and heater which assists in preventing a fluctuation of the oil pressure at the burners. It is especially desirable to keep a constant pressure of the oil at the burners when compressed air is used to atomize the fuel.

In the latter case the storage tank should be provided with a drain cock to allow the accumulated water to be removed occasionally. The feed lines should be at least from 1½ to 2 inches in diameter. They should be so located that they are kept warm by the radiant heat of the furnace walls. This helps to dry the air and to raise its temperature. The higher the temperature of both oil and air the better the combustion will be. A main leader for the oil and one for the atomizing agent should be installed on each side of the furnace, starting from the melting end. Branch lines should be run to the ports of the tank and to the nose of the furnace. These lines should be reduced to the size of the pipe opening into the burner, which may be ½-inch. Individual control of both the oil and the atomizing agent is obtained by installing valves on each line. The burners should be placed at an angle so that the flame strikes the molten glass. They should be set at least one or two inches outside of the ports of the furnace. It is good practice to make a shield of tile or galvanized iron to protect the burners which are not in operation, which prolongs their life.

Where there is no port opening in the nose of the furnace, arrangement should be made to have burners installed so as to assist in keeping the glass heated sufficiently for proper working. The main feed lines should have control valves for each side of the furnace to permit alternate firing. The periods are from thirty to forty-five minutes in duration, depending on the design of the furnace. The air should be carefully adjusted. Too much cold air should not be allowed to pass through the burner ports. The operating force will soon become familiar with the adjustment of the atomizing valve and the oil valve. The flame should not be carried through the furnace too quickly. The stack draft should be so regulated as to allow full utilization of the available heat. Good combustion conditions are identified by a gray haze at the top of the stack; smoke means waste. On the other hand it is not good practice to have the gases remain in the furnace for too long a period of time. The required amount of oil and air pressure should be available to properly assist the burners in securing perfect combustion.

*Clyde, N. Y., Representing John Foerst & Sons.

Glass Manufacture With the Electric Radiation Furnace

By V. M. SAUVAGEON*

The first attempts at glass making by electricity were made in Germany and Austria. They were started in 1881 by Reich and were followed by those of Askenasy, Becker, Walker, etc. The results obtained with the apparatus used were not sufficiently encouraging to undertake work on a manufacturing scale. In the United States some inventors took out patents on this subject, but to our knowledge no practical results were obtained.

Detailed reports of these different attempts have been published by different authors, especially by M. A. Granger in 1907 and J. Escard in 1918. We will not refer to these, but will limit our discussion to the work which we have done ourselves.

Our experiments started in 1908, at our own expense, and were carried on since 1910 under the auspices of the Electric Glass Society, organized on account of the encouraging results which we have obtained. The work was done in the plant of the Société des Carbures Metalliques, located at Notre Dame de Briançon (Savoie,), where working space, power and every facility were given to us through the courtesy of our eminent colleague M. H. Gall, president of the administrative board of the company.

FIRST ATTEMPTS.—Our first attempts were made with furnaces heated exclusively by the passage of the current through the container of the glass, which formed a resistance, the transformation of electrical energy into heat being due to the resistance caused by the container. We built first a number of small furnaces, measuring 1½ meters in length and ¼ meter in width, which worked fairly well and gave glass of satisfactory quality. We constructed then a large tank furnace having an inside length of 4½ meters by 2 1/10 meters width, which contained a series of fixed electrodes, placed at each side of the tank. This installation functioned for 46 days and a production up to 1,500 kilograms of glass per day was obtained. Bottles and tubing were produced. The power needed was 300 kilowatts and the temperature obtained inside of the furnace was 1,400 deg. C.

It was recognized that this furnace was not well adapted for industrial use, because on the one hand the heat was too concentrated in the tank, which caused a rapid deterioration of the walls, and on the other hand the heating by the passage of the current in the working zone was such that it was impossible to obtain glass without defects.

It was then decided to build a new tank furnace, 2.9 meters in length and 1 meter in width, having a heating circuit above the cap and also one inside of the tank. The cap was made very thick, and of a material which did not transmit heat very well. The installation worked for 37 days and produced up to 900 kilograms of glass per day. The power needed was at an average of 170 kilowatts, the temperature obtained was 1,500 deg. C., and the glass was of better quality than that produced in the preceding furnace. However, the result obtained was still considered insufficient, for the concentration of heat inside the tank remained too high. It was recognized that the heating through the cap should be increased as much as possible, so as to heat by radiation and to imitate as much as possible the heating conditions obtained by burning gas. For this reason we have made a special study of this method of heating and have searched for the proper materials for building the cap and the proper composition of the resistant material.

With this object in view, we have made a series of small furnaces, heated exclusively by radiation from the cap, made of material containing magnesia, above which an electric furnace was located. The resistance material which was adopted after these experiments was absolutely pure carbon, made into graphite in the furnace itself. We rejected all combinations of carbon with other materials, used up to this time, which at the high temperatures obtained gave resistances which were too variable. These small furnaces have given good results and have yielded glass of a good quality.

After these different trials it was resolved to abandon the heating by passing the current through the tank, and our furnaces from then on were heated by radiation of the cap and the side walls. We will describe the results obtained with a furnace of that kind.

RADIATION FURNACE.—The radiation furnace which we have built contained a pot. It measured 1.2 meter inside length and 1.37 in depth, 1.16 in height, and held a pot which could contain 400 kilograms of glass. This furnace was constructed in two distinct parts. The lower part formed a basis of refractory material placed on supports which permitted the circulation of air. No electric current passed through this part. The upper part, consisting of the side walls and the cap, in which the current passed, formed the heating part of the installation. There were three sections and their walls were made from magnesia containing less than 0.07 per cent iron oxide. Such material, as we have found by special study, is very refractory, and is a good conductor of heat, very strong and, above all, not breakable. At each end of the furnace the carbon electrodes were placed, with the heads outside of the furnace. A large number of electrodes were placed and were connected with the line carrying the electric current. In the chambers were placed the resistant matereial, consisting of petroleum coke in small granules, which is transformed into graphite when the furnace is started. Above each chamber an opening was made to allow access to the resistant material even while the process was going on. Through this opening the resistant material could be cleaned, made homogeneous or replaced when it was used up. The cap and the sides of the furnace were made especially heavy, which made the transmission of the heat to the melting chamber slow and which reduced the output. The space between the bottom, the sides and the cap of the furnace constituted the working space which contained the pot. The latter could be reached through a conveniently located opening in one of the sides. The electric current used was a one phase alternating current. Regulation was

*_Chimie et Industrie_, Vol. 7, No. 3, pp. 452-455. Translated for THE GLASS INDUSTRY.

obtained by a transformer which reduced the current density, followed by a density regulator. The latter apparatus permitted the regulation of the voltage within very small limits and consequently allowed an even regulation of temperature.

The principal characteristic of this furnace is that the current does not run through the material, therefore the workmen are secure from danger, and any contamination or decomposition of the glass is precluded. The furnace was discontinuous; that is to say, in the pots were made the successive steps of operation: melting, fining, cooling and working. According to our calculations, the furnace consumed about 150 kilowatts at the time of maximum heating. It was built at the beginning of 1914. The preheating took place by its own power from the 11th until the 15th of May, therefore during fully five days the rise in temperature was very gradual, from 25 deg. C. on until 1,000 deg. C. at the end of the period. The cooling took place for six days. At that time the furnace was opened to receive the pot, which had to be preheated before being put into service. The actual work started on June 11th and was carried out in the same way as the preliminary heating, by raising the temperature slowly. From 55 deg. at the start a temperature of 850 deg. was reached on the 17th. From that time on, due to the absence of some interested parties, the temperature was maintained stationary until the 27th. During this 10 day period the average consumption of current was 42 kilowatts. From that time on the temperature of the furnace was raised slowly, and on the 29th of June, in the evening, it was 1,070 deg. The pot was then filled with cullet. The glass was well melted and the furnace attained a temperature of 1,425 deg. C. on the first of July. The charge was then removed and fusion of batch was started, having the composition of window glass. The furnace was run until the 18th of July by making a series of glass fusions. The temperature of the furnace was raised every time until the end of the run to obtain a glass which was well melted and fined. The operations were always stopped at a temperature ranging between 1,350 deg. and 1,400 deg. C. The runs were fairly long, due to the heavy cap which retarded the transmission of heat. The power consumed has never exceeded 134 kilowatts and has generally been kept around 100 kilowatts. From June 29th until July 3 two runs were made which together yielded 750 kilograms of glass in 84 hours. If 13 hours are deducted, which are necessary for the cooling down of the furnace and the glass at the end of the run, and during which time no current was used, there remained 71 hours of actual heating. The consumption of power was 8,840 kilowatt hours, with a maximum of 132 kilowatts at the time of the strongest heating. This corresponds with 11.35 kilowatts per kilogram of glass, representing a production of 2.11 kilograms of glass per kilowatt day. We hope to attain about 4 kilograms for this small type of furnace and for this type of glass, which is especially difficult to fuse.

During the operation of the furnace there occurred several stops in the supply of electricity, one of which lasted nine hours. The manufacturing was simply stopped at these times without trouble to the furnace, which every time had to be reheated for some hours to regain the former temperature. Some ends of electrodes became red and had to be replaced during the run, which was done without difficulty. If heavier electrodes had been used, or those with water cooling, these incidents would not have happened.

The furnace was stopped on July 18th on account of breakage of the pot. Continuation of the experiment would have required the cooling down of the furnace to set another pot. It was decided for the time being not to continue the work.

The experiments with this furnace allow us, in our opinion, to draw the following conclusions:

The furnace is of a rugged construction, easy to regulate in all its parts, and of simple operation.

It can be started directly and through its own installation, and stopped during the run without other inconvenience than the stoppage of the manufacture during the time necessary to bring it back to the proper temperature.

It has every element of safety for the workmen who operate the furnace, since the current does not run through the working end.

The current does not run through the materials to be melted or heated and cannot decompose or change them.

The furnace was constructed so as to make it possible to attain temperatures ranging from the lowest up to 1,425 deg. C.

The cap was made much too thick, otherwise it would have been possible to obtain a much higher temperature and, above all, a higher yield of the furnace. As far as the manufacture of glass is concerned, the furnace was entirely practicable and gave glass of a good quality.

With a few minor modifications we believe that the apparatus can be used on a manufacturing scale. The electric furnace makes possible the manufacture of better combined and more resistant glass on account of the absolute uniformity of the high temperatures of fusion and fining. It permits also new combinations, such as glasses very high in silica and possessing a strong insulating capacity. In fact, in the course of our experiments we have made glass containing 82 per cent silica.

The electric furnace in the glass industry is especially applicable to continuous tank furnaces for nearly all kinds of glass. The consumption of electric current varies, of course, with the composition of the glass and with the temperature of fusion and fining. For a tank furnace running 7,200 working hours per year, deducting Sundays, holidays and stops for repairs, we estimate that, according to the nature of the manufactured glass, there will be a consumption of 0.3-0.5 kilowatt year per ton of glass melted and fined (representing a production of from 7-11 kilograms glass per kilowatt day), corresponding to from 800 to 1,500 kilograms coal used in a gas producer.

For a furnace with two pots of 600 to 700 kilograms running under the same conditions, we estimate that there will be a consumption of from 0.35 to 0.55 kilowatt years per ton of glass produced (representing a production of 5-9 kilograms glass per kilowatt day), which corresponds to 600-1,200 kilograms coal used in an efficient gas producer. It should be understood that these figures still have to be verified in practice, but we hope that the type of furnace which we have described will be used in the not far distant future and that we may be able to check up our figures and our conclusions.

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NEW YORK, FEBRUARY, 1923

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CLASSIFIED BUYERS' GUIDE, PAGE 16

To Survive—
Modernize

Passing Fancies

To many readers of technical journals it has been a relief to notice the disappearance from the printed page of organization charts, so dear to the heart of technical writers during the war, and as long after as the period of war-psychose has lasted. In executive offices also, organization trees have a forlorn appearance. Some of them have been taken down during the readjustment period following the recent business depression, and are now languishing somewhere in the storeroom, with scant chances of resurrection. It has evidently been the experience that Arthur D. Little was right, when he said: "There is great danger in an organization chart—someone might mistake it for an organization."

Silent sufferers of over-organization have known for a long time that good management is not such a simple matter that it can be solved through the magic of lines and circles, however ingeniously arranged. Efficiency experts have no doubt obtained results, but only in those cases where they happened to understand that human beings are different from machines. In many instances they have demonstrated themselves to be a source of irritation and a good deal of a nuisance to all who had dealings with them.

Some time ago announcement was made in the daily press of the establishment of what amounts to a psychological testing laboratory. Applicants for positions may be referred to this agency which will undertake to test their ability for certain jobs, like a sample of fuel is submitted to a chemical laboratory for the estimation of its heating value. It is feared that this institution has appeared on the scene too late. Industry and commerce are not making money easily enough these days to have any available for psychological experiments and will continue to depend on the proven judgment of those entrusted with the selection of new employees.

Applied science has accomplished wonders and there appear to be no limits to its possibilities. But in recent years a great mass of pseudo-science has sprung up. Numerous would-be scientists have succeeded in obtaining an enormous amount of newspaper publicity on account of the appeal which their claims make to the general public. Especially during the war their aggressive methods have gained the attention of those in the seats of the mighty. As a result much time and money has been spent in "co-ordination and extension" of various "activities," which have been later revealed to be either misdirected efforts or just plain bunk.

The history of prosperous enterprises and the lives of successful men continue to prove that there is no substitute for hard work; that results will come, as they always have, from individual effort, from managerial ability obtained by years of experience and by a realization that men have hearts as well as brains. Attempts to supplant a formula for labor, "tests" for judgment and a system for personality has always ended in a farce, and oftentimes in disaster.

An investigation of the effect of washing compounds on glass surfaces has been started as a part of the research work of the Bureau of Standards. Chemical analyses have been made and tests of the tendency of different compounds to attack glass surfaces are under way.

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility **THE GLASS INDUSTRY** is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to submit them.

Questions should be submitted in writing and will be answered by mail as promptly as possible. The sources of all inquiries will be held in strict confidence.

Question 41 (from France).—Flint Glass in Tank Furnaces.

1. By what means is it possible to obtain and keep flint glass in a tank furnace when using sand and calcium of the following analyses:

SAND ANALYSIS

Silica	99.8	per cent.
Alumina	0.1	" "
Iron oxide	0.01	" "
Lime	0.05	" "
Sulphuric acid	0.04	" "
	100.00	" "

CALCIUM CARBONATE ANALYSIS

Water and organic matter	0.22	per cent.
Silica and alumina	0.98	" "
Iron oxide	0.065	" "
Calcium carbonate	97.95	" "
Magnesia carbonate	0.64	" "
Not determined	0.145	" "
	100.000	" "

2. Can you give us a batch with our sand, so as to obtain flint glass which will be used in the making of flagons by means of automatic machines.

3. Will we have to use blue powder and what sort of a batch will it be.

4. What precautions shall we take to prevent the glass coloring and in case the glass should be colored, what means should be undertaken to remove this coloring.

Answer.—We desire to state that in our experience it is difficult to make a colorless glass permanently in a tank. While a good grade of glass can be made for a few days, it has been observed that after a short time the glass becomes slightly darkened, probably due to the action of the fire gases. However, if a very high quality is not essential it is practicable to make a fair grade of glass in a tank, provided pure raw materials and clean gas are available.

With the sand and limestone according to your analyses and using a pure soda ash it should be feasible to make a fair grade of colorless glass in a tank.

In this country it has been found that a suitable composition of glass used in connection with automatic machinery is as follows:

Silica	74-75	per cent.
Calcium oxide	7-8	" "
Sodium oxide	16-18	" "

With sand and limestone as given in the analyses, and assuming that the soda is 99 per cent pure, the following batch should be used.

Sand	100	k.g.
Limestone	19	"
Soda ash	42	"

This batch would yield a glass of about the following composition.

Silica (SiO_2)	74.10	per cent.
Calcium oxide (CaO)	7.90	" "
Sodium oxide (Na_2O)	18.00	" "
	100.00	" "

To improve the color, 4 grams of nickel oxide per 100 k.g. of sand should be added. If powdered blue is preferred it is important to know the percentage of nickel oxide which it contains, and a quantity equivalent to 4 grams should be added for each 100 k. g. of sand.

For further discussion of this subject we refer you to the article on "The Production of Colorless Glass in Tank Furnaces" reprinted in our October, 1922, issue, pages 200-205, from the *Journal of the Society of Glass Technology.*

Pittsburgh as a Ceramic Center*

By ALEXANDER SILVERMAN†

Pittsburgh has acquired such prominence as an iron and steel center that other industries of our district are often forgotten. Twenty-five years ago a group of young enthusiasts, realizing that something beside iron and steel was made in our city, organized the American Ceramic Society, whose twenty-fifth anniversary will be fittingly celebrated here February 12 to 16, 1923. The Society has grown during that period from a score of members to several thousand.

Our city was the logical center for a pioneer glass industry, through her natural resources, coal, gas and sand, and proximity to good limestone beds. The early work on window glass was done here; also, in the field of plate glass manufacture. Today, we not only lead in the manufacture of these, but make illuminating and table ware, bottles, art glass, and all sorts of glass specialties.

Pittsburgh's prominence in the ceramic field is not confined to glass. There are few centers where as much enameled sanitary ware, such as bathroom fixtures, is manufactured. We also make enameled cooking ware.

The refractories history of the "Steel City" is a long one. The older members of our section well remember the many brick plants of their childhood. Today the manufacture of refractories for all types of furnaces, kilns and ovens, is a vast and indispensable part of Pittsburgh industries. Not only are the plants located here, but the research for the American Refractories Association is conducted in Pittsburgh.

China and pottery found a permanent center around Beaver Falls and Rochester, Pa., and it is only a short run to Wheeling and the East Liverpool, O., potteries, where much Pittsburgh capital is invested.

This is a brief outline of the local ceramic industry. It is not our purpose to burden the reader with details, but the following figures, compiled by the Pittsburgh Chamber of Commerce for the year ending December 31, 1921, are significant:

	Number of plants	Number of Employees	Total Annual Wages	Capital Invested	Output for 1921
Artificial Stone	5	97	$ 143,500	$ 395,000	$ 661,400
Building Brick	22	525	733,200	1,270,100	1,386,300
Cement	1	669	1,410,300	998,000	5,386,000
Crucibles	2	62	142,400	584,400	499,400
Glass Bottles	5	1,085	1,318,100	1,540,200	2,874,300
Cut Glass	1	8	5,400	8,500	6,000
Decorative Glass	10	205	263,200	233,900	1,012,300
Plate Glass	3	1,081	1,807,200	1,474,500	5,605,500
Glass Table Ware	7	1,267	1,465,000	1,339,000	3,037,400
Window Glass	1	28	29,000	61,000	60,000
Lamps & Chimneys	2	507	718,000	573,300	1,879,500
Paving Materials (not brick)	1	15	17,700	15,200	168,300
Terra Cotta and Fire Clay Products	7	1,078	1,374,800	8,163,200	2,623,400
Asbestos Products (not roofing)	2	162	183,300	589,300	297,300
Enamel Ware	2	288	307,300	358,500	948,500
Wall Products	2	13	17,600	34,400	103,400
Miscellaneous	2	3	3,800	3,300	56,000
Totals	75	7,093	$9,939,800	$17,641,800	$26,605,000

While these statistics may not include every ceramic plant of the Pittsburgh district, they indicate the magnitude of the ceramic interests of our city.

*_The Crucible_, January, 1923.
†Head of the Department of Chemistry, University of Pittsburgh.

New Publication

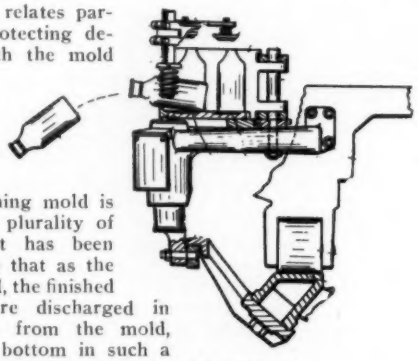
Technologic Paper T222, Bureau of Standards. Relative usefulness of gases of different heating value and adjustments of burners for changes in heating value and specific gravity. Walter M. Berry, I. V. Brumbaugh, J. H. Eiseman, G. F. Moulton, and G. B. Shawn. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price 25 cents.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

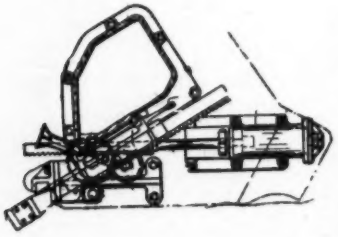
Glass Mold. U. S. 1,439,355. Dec. 19, 1922. Thomas A. Bragg, of Toledo, O., assignor to the Owens Bottle Company, of Toledo, O.



This invention relates particularly to a protecting device for use with the mold bottoms on a glass forming machine. In machines of the type herein illustrated, in which each finishing mold is provided with a plurality of mold cavities, it has been found in practice that as the molds are opened, the finished articles which are discharged in rapid succession from the mold, strike the mold bottom in such a manner as to cause rapid wear of said bottom.

To prevent such wear a striking plate or shield is attached to the bottom plate as by means of a screw in such position that the bottles as they fall from the mold will strike said shield and thus be kept from striking the mold bottom. The plate is readily detachable.

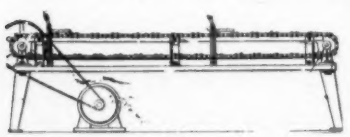
Glass-Cutting Mechanism. U. S. 1,439,368. Dec. 19, 1922. Richard La France, of Toledo, O., assignor to the Owens Bottle Co., of Toledo, O.



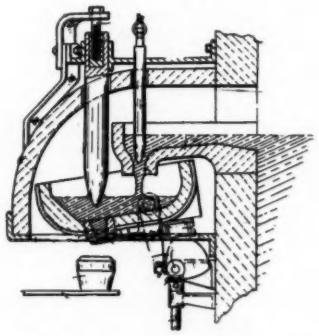
This invention is adapted to an Owens automatic bottle forming machine which comprises a series of blank molds carried on frames or arms on a mold carriage which rotates continuously about a vertical axis so that the molds are brought successively to gathering position over the tank. Each mold as it is brought over the tank is lowered into contact with the molten glass in the tank and the glass drawn by suction into the mold. The mold is then lifted and a cutter blade carried on an arm is projected horizontally, and thereby severs the glass in the mold from the string of glass which extends from the mold to the pool as the mold is lifted. After this operation the knife is moved vertically downward before it is withdrawn horizontally.

Process for Forming Glass Articles and the Apparatus for Carrying on Same. U. S. 1,439,698. Dec. 26, 1922. Reiner W. Erdle, of New York, N. Y., assignor to the Cold Light Manufacturing Company, a corporation of Colorado.

This invention relates particularly to the making of tubular glass containers of self-luminous materials to be attached to the ends of pull chains on electric light sockets and locate the chains in the dark. These containers, which are closed at one end and open at the other, are filled with self-luminous material and the open end is sealed with a suitable plug. A sheet metal cap is secured to the open end of the container for attachment to the end of the pull chain, and in the form contemplated herein, the container is provided with a bead or enlargement at its open end over which the sheet metal cap is spun or otherwise secured. The process contemplates taking a piece of glass tube of the proper length to make two containers, and first heating and sealing the ends thereof, thereby trapping the air therein, and then circumferentially heating the tube at substantially its middle point thus causing the trapped air to expand and press out the plastic glass and produce a circumferential enlargement or bead. The article thus formed is cut in two through the central enlargement or bead.

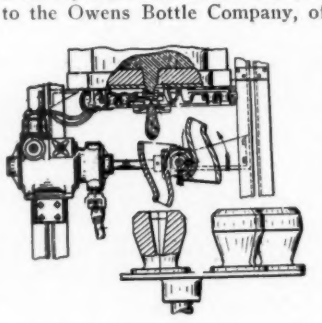


Means for Feeding Charges of Molten Glass. U. S. 1,439,369. Dec. 19, 1922. Richard La France, of Toledo, O., assignor to the Owens Bottle Company, of Toledo, O.



This invention in its preferred form comprises means for flowing the glass continuously from the main tank into a basin or receptacle having a discharge opening in the bottom thereof. This basin is mounted to rock about a horizontal axis, so that the glass therein surges or flows back and forth, whereby the head of glass over the discharge outlet is periodically increased and decreased. This causes a corresponding fluctuation in the flow of glass through the discharge outlet, so that the glass is delivered in masses or gobs which are automatically severed by a cutter located beneath the outlet. The invention further comprises a regulator which may consist of a stationary plug or rod projecting vertically downward into the glass directly over the outlet. This regulator assists in forcing the glass through the outlet as the latter moves upward, and also assists in retarding or interrupting the discharge as the said outlet moves downward, owing to the glass adhering to the regulator.

Means for Transferring Glass to Molds. U. S. 1,439,384. Dec. 19, 1922. Leonard D. Soubier, of Toledo, O., assignor to the Owens Bottle Company, of Toledo, O.



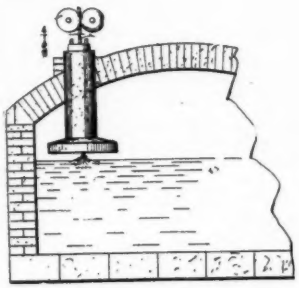
This invention is particularly adapted for transferring the charges or gobs of glass to the molds on a continuously rotating glass forming machine.

The molten glass is supplied from a container which may be a boot or extension of a glass melting tank. The glass flows through an outlet opening in the bottom of the boot in the form of a sluggish stream or column from which mold charges or gobs are periodically severed by shears. An air motor having suitable connections for operating the cutters is operated by compressed air supplied through a pipe. The operation of the air motor is controlled by suitable mechanism within a casing containing gearing driven by a vertical shaft.

In order to accurately guide the gobs into the parison molds as the latter travel beneath the outlet, a pair of funnel shaped

guides mounted on a continuously rotating horizontal shaft are provided. These guides are oppositely disposed and so arranged that they are brought alternately into guiding position with the large end directly beneath the flow and the lower constricted end directly over or in register with the opening in a parison mold.

Apparatus for the Manufacture of Glass Canes. U. S. 1,439,855. Dec. 26, 1922. William Westbury, of Okmulgee, Oklahoma.

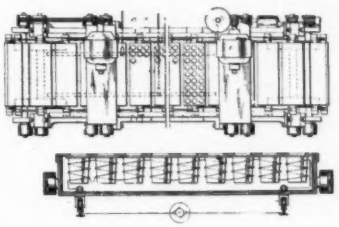


The invention relates to the manufacture of canes of glass or analogous vitreous material, the process being the same whether the canes are solid or tubular.

In accordance with the method, the inventor claims, the glass or like material in a molten state is drawn therefrom in a cane and simultaneously cooled, the initial cooling at or near the surface of the molten glass being rapid to set the cane by a chilling action and the subsequent cooling being gradual to prevent the cane from becoming too brittle. By varying the effective temperatures and the speed of the draw, either or both, the diameter of the cane produced may be regulated.

The molten glass or kindred material may be held in a pot, tank furnace, fore-hearth, dog-house or other container. A portion of the surface of the molten glass is chilled and the cane is drawn from the chilled spot and is initially set by a rapid cooling and subsequently gradually cooled.

Apparatus for Annealing Glassware. U. S. 1,439,305. Dec. 19, 1922. Ira H. Freese, of Clarksburg, West Virginia, assignor to Hazel-Atlas Glass Company, of Wheeling, W. Va.



Invention relates to the annealing of glassware and comprises providing a plurality of containers for the ware, in which the temperature may be carefully regulated. The containers are mounted on an endless belt and the improved apparatus is of the portable type and can be moved about as desired, which is claimed to be a great advantage as compared to the ordinary masonry annealing furnace.

The inventor claims an apparatus for annealing glassware which comprises a plurality of closed vessels having a plurality of receptacles therein for the reception of articles of glassware, an electric heating element in each vessel, a series of separated contacts for supplying current to such vessels at successively varying voltages, and means for moving the vessels successively into engagement with said contacts; each receptacle being separated from the other receptacle in vessel by a clear air space around the sides and bottom thereof.

Rights of Manufacturers and Producers Under the Tariff Act of 1922*

By Former Presiding JUDGE MARION DE VRIES†

Every American manufacturer and producer should realize the new and highly important rights secured him by the Fordney-McCumber tariff law and be prompt to avail themselves of them. The protection of his interest and that of his employes so demands.

The long struggle of American manufacturers and producers for equal rights with importers in matters of tariff construction, before the departments of the government and the courts has, by that act for the first time, been rewarded by the therein provided methods of assertion of these rights. By what means of logic they had theretofore been denied is difficult of understanding.

While American manufacturers had for years contended in the courts and before Congress for the exercise of the right of contesting rates of duty and constructions of the tariff law, it has never before in its fullness or in any adequate measure, been granted. Many years since an American manufacturer, after several unsuccessful attempts, was finally upheld by the United States Court of Custom Appeals in protesting in favor of a higher duty than that levied by a Collector of Customs. The Underwood Tariff Act, however, soon thereafter by express legislation denied this right to American producers.

Early in the hearings upon the present act, in January and February, 1921, the subject was clearly elucidated and forcibly presented to the Ways and Means Committee of the House of Representatives, by Mr. A. Cressy Morrison of New York. Unto his advocacy and persistent effort we are much indebted for the enacted law. His clear epitome of the situation in his testimony before that Committee may well be quoted as a concise analysis of the rights contended for and by the law now provided. He stated:

> A protective tariff involves three parties, though perhaps a revenue tariff may involve but two. In the case of a revenue tariff the two parties are the importer and the United States. In the case of a protective tariff the three parties are the United States, the importer, and the industry affected.
>
> I have gone through the report of the United States Tariff Commission on the revision of the administrative features of the tariff laws. I am not an expert and could not qualify on that at all; and am therefore passing no opinion as to the character of this proposed modification, except to say that a careful examination of this revision discloses the fact that it is built upon the assumption of a revenue tariff; that is, a two-party tariff, involving only the Government and the importer.
>
> So far as I can see, there is nothing in this report of the Tariff Commission which gives the domestic industry even by inference, any contact with the customhouse, any rights or any opportunity to aid the Government in the collection of revenues or to protect itself.
>
> I feel that such rights should be accorded, especially in the case of a protective tariff.
>
> I wish to make the point now that some consideration under a protective tariff, should be given to the American industries * * * I urge you in simple justice to give the same rights of information, protest and appeal to the American producer that are now accorded to the importer and the agent of the foreign manufacturer.

As pointed out by Mr. Morrison, this tariff act directly and vitally affects the immediate interest of three parties, the Government, the manufacturer, and the importer. Heretofore, manufacturers were, after presenting their needs at Washington, denied any effectual participation in the construction of tariff acts. Thereafter, while the importing interests were empowered by law to protest against any appraised value, or any rate of duty, or any construction of that law, as applied to any imported merchandise, before the Board of General Appraisers and the courts, manufacturers were not so empowered. Indeed even indirect intervention was denied them. In consequence, assaults to tear down the secured protection to manufacturers were immediately inaugurated by the importing interests, without any legal right provided the manufacturers and producers to resist, intervene, oppose importer's claims, or to assert a similar right. These constant assaults

*Washington Service Bulletin, National Association of Manufacturers.
†Associate and Presiding Judge, United States Court of Customs Appeals, 1910-1922.

upon previous tariff acts by importers necessarily resulted, in many cases, in a destruction of intended protection. Some idea of these activities will be had by the fact that since the Board of General Appraisers was created, June 1, 1890, 1,192,707 protests were filed against collector's assessments on classification. Many protests so filed never reached the board in due course of administration, being held by collectors for review, or awaiting decision of similar protests by the board. That such was their moral as well as legal right is not denied. On the contrary it is asserted and justified, for every interested party should have his day in court as to any law affecting his interests. That is simple American justice. But while rightly accorded one party in interest it should not have been denied another party in interest.

While the Government was represented from the revenue standpoint, the legal theory of that representation was rightly one of neutrality in so far as the conflicting interests of importers and producers were concerned. But the protective features of the act had no legally authorized champion. Nor was it just that the burdens of conflicting interests of either importer or manufacturer should be borne or asserted by the Government.

This one-sided bombardment during the life of a tariff act necessarily resulted in greatly breaking down of its protective features.

It must be borne in mind that the government counsel in charge of its customs legislation has not now and never has had the right of protest. The functions of such government counsel now and ever have been to *defend suits brought by importers.* It never was and is not now its duty or legal right to study the act and insist in court upon *higher* rates of duty being levied. They can and could only defend a rate or construction assailed by an importer. While the importers of legal and moral right studied the act, word for word, selected the provisions they deemed most favorable, protested and asserted their views before collectors and in the courts, neither government counsel nor the American manufacturers had that right. That right, however, is by the current act granted, as well as the right to oppose importers' claims, and, without doubt, if vigilantly exercised by manufacturers, sustaining Congressional intent, will result to their tremendous advantage.

This act expressly accords the right to all manufacturers and producers to intervene and protest any rate levied or construction had by a collector or value assessed by an appraiser. For the first time in history, in this particular, American manufacturers and producers are put upon the same legal footing with importers and can intervene in upholding in its integrity the enacted law.

Hundreds of thousands of protests have been filed by importers against every tariff act of recent years. A great percentage of these have been sustained by the departments or courts. For several decades the court records show on final decision between forty and fifty per centum of importers claims to have been sustained. It stands to reason that if this vast number of errors were made against importers, a multitude were likewise made against the manufacturing interests which, with the present right of intervention and protests, could have been asserted in the customs tribunal and courts and corrected by the interested manufacturers. And, without doubt, many contentions of importers could have been, with more diligent scrutiny of customs administration and the added opposition afforded by this act, defeated.

It, therefore, vitally behooves every manufacturer, as an individual or by joining with those of like and similarly interested industries, to be vigilant of, assert and defend before the customs officials, tribunals, and courts the protection accorded them by the existing law.

Further relief is afforded manufacturers and producers by the elastic or flexible, the dumping, and the countervailing provisions, sections 315, 316 and 317, of the current act.

In fact, assembled in these provisions are all the powers of Congress to secure this protection for the interests of American manufacturers, through the remedies therein provided and the functions delegated the United States Tariff Commission and the President. These provisions are open to be availed of at any moment when a rate of duty is found insufficient to protect any particular or class of industries, or there is discovered an unfair transaction affecting any particular trade or business. Full procedure is now provided by rules of the Tariff Commission at Washington for manufacturers or producers to have raised under certain conditions the rates applicable and to have changed an unfair, unequal or unjust classification. Or, wherever foreign duties, discriminations or regulations close to the American manufacturers or producers the markets of any competing country, complete procedure is now provided whereby on application of American producers such may be relieved.

By this act complete guaranty is given our manufacturers and producers of the intended and the just protection afforded by the act, and fair treatment by foreign trade competitors and by foreign governments.

American manufacturers and producers should awaken to these new and tremendous possibilities thus secured them, and avail themselves of these accorded rights.

Miscellaneous Items

Federal Judge D. C. Westenhaver at Cleveland, O., on January 24, refused to continue the temporary restraining order granted on January 5 by Federal Judge Killits of Toledo, sitting at Cleveland, preventing the National Window Glass Manufacturers' Association and the window glass workers organization from carrying out their working agreement, and took under advisement the case of the United States Government against the wage scale committee of the two organizations.

The restraining order was issued after the indictment of sixteen members of the Joint Wage Committee by a Federal Grand Jury on charges of entering into an agreement to curtail the production of window glass, in violation of the anti-trust laws.

Judge Westenhaver's refusal to continue the injunction left the indicted manufacturers who have been operating during the first period, in a position to close their factories according to schedule on January 27, provided no decision was reached in the case before that date.

Pending the outcome of the indictment of the sixteen members of the Joint Wage Committee, the wage agreement for the second period, effected at Cleveland on December 29, 1922, which provided for an increase of 13 per cent to the glass workers (including the 10 per cent increase which was put into effect on December 1st) was suspended.

Following the successful Forty-Third Annual Glass Exhibit at Pittsburgh, the Associated Glass and Pottery Manufacturers was organized and will incorporate for the purpose of making Pittsburgh the permanent location for consolidated exhibits and furthering the interests of the members in every possible way.

An open competitive Civil Service examination for junior engineers, junior physicist and junior technologists for the Bureau of Standards will be held by the United States Civil Service Commission on March 7, 1923. Full information can be obtained from the Commission's office at Washington, D. C.

The second Chicago Exhibit of glass, pottery, lamps and housefurnishings will be held at the Congress Hotel, February 5 to 17, 1923. Seven floors of the hotel will be occupied by the manufacturers' displays, and about two hundred exhibits will be represented.

Automatic Sealing Machine

A labor saving device which is being adopted by progressive glass factories is manufactured by the Standard Sealing Equipment Corporation, 69 Vestry street, New York. This is an automatic machine for sealing the tops and bottoms of corrugated or solid fibre shipping cases. The cases are put into the machine at one end and after being sealed are kept under pressure while traveling through the machine for a sufficient period to insure thorough sealing. The machines are made in different capacities to take care of the varying requirements of different factories.

The Glass World and What It Is Doing

News of the Industry

American Ceramic Society Silver Jubilee Convention

"The most thoroughly planned and most important convention this society has ever held" is the way Secretary Ross C. Purdy characterizes the Silver Jubilee of the American Ceramic Society to be held this month at Pittsburgh, Pa., and a study of the program arranged for the general and divisional meetings, plant visits and other activities supports his assertion.

In celebration of the anniversary of the birth of the Society in Pittsburgh twenty-five years ago, every effort has been put forth to make the meeting an unqualified success. The hotels William Penn and Fort Pitt will be the centers of activities. Meetings will be held on Monday, Tuesday and Wednesday, February 12, 13 and 14, and the following two days will be occupied with visits of inspection of various manufacturing plants. Ample provision has been made for the entertainment of the ladies who are cordially invited to attend.

The nomination of officers to be elected at the annual meeting for the year 1923-24 are as follows: President, A. F. Greaves-Walker; vice-president, R. D. Landrum; treasurer, R. K. Hursh and trustee, R. R. Danielson.

The complete program of papers to be presented at the meeting, and schedules of plant visits will be issued February 1. The program will include a general business and technical opening session on Monday, February 12, in the Ball Room of the Hotel William Penn. President Frank H. Riddle, Prof. Charles F. Binns, B. E. Salisbury, J. D. Ramsey, De Witt F. Riess, E. W. Washburn, A. E. O. Munsell, Dr. H. Foster Bain, director of the United States Bureau of Mines, T. E. Wilson, president of the Pittsburgh Clay Club, and other men prominent in the ceramic industries are scheduled to deliver addresses.

On Tuesday and Wednesday, February 13 and 14, separate meetings of each of the seven Industrial Divisions of the Society will be held at the Fort Pitt Hotel. On Tuesday evening there will be a supper and entertainment.

The complete program of papers to be presented at the Glass Division meetings had not been announced up to the time of going to press with this issue, but a list revised up to that time is given below.

Papers to Be Presented at Glass Division Meetings

BETTER GAS—BETTER COMBUSTION—BETTER BEGIN, by W. B. Chapman.

COLD, CLEAN ARTIFICIAL GAS AND A DISCUSSION OF THE GENERAL PROPERTIES OF GASEOUS FUELS, by A. E. Blake.

A COMPARISON BETWEEN ENGLISH FURNACE CONSTRUCTION AND OPERATION AND MODERN AMERICAN PRACTICE, by R. L. Frink.

OBSERVATIONS ON THE EUROPEAN GLASS INDUSTRY, by H. W. Hess.

THE ADVISABILITY OF PURE RESEARCH ON GLASS IN AMERICAN UNIVERSITIES, by Alexander Silverman.

FURNACES FOR THE MELTING OF GLASS IN THE LABORATORY by A. E. Badger and C. D. Spencer.

GLASS WOOL HEAT INSULATION IN EUROPE, by A. D. Saborsky.

RESULTS OF MECHANICAL TESTS ON WINDOW, PLATE AND ROLLED SHEET GLASS, by Arthur E. Williams.

SOME EFFECTS PRODUCED BY THE CHILLING AND ANNEALING OF GLASS, by A. Q. Toole.

TENSILE STRENGTH OF GLASS, by J. T. Littleton.

THE VISCOSITIES OF THE SODA-LIME-SILICA GLASSES BETWEEN 800 AND 1,500° C., by E. W. Washburn and C. R. Shelton.

THE SURFACE TENSIONS OF THE SODA-LIME-SILICA GLASSES AT HIGH TEMPERATURES, by E. W. Washburn and G. R. Shelton.

THE RESISTANCE OF SODA-LIME GLASS TO WATER, by L. A. Palmer.

A STUDY OF THE ORIGIN AND CAUSE OF STONES IN GLASS, by Herbert E. Insley.

HOW TO GET RID OF SCUM ON A TANK MELTING FLINT BOTTLE GLASS, by J. William Cayner.

Discussions of papers read at the meetings will be invited. In answer to a questionnaire, requests have been received for discussion of the following subjects:

Cause of seeds in selenium decolorized glass.
Sulphuring of glasses.
Use of pyrometers.
Sillimanite as a glass refractory.
Improvement of the life of tank furnaces.
Cause of failure of tank blocks.
Combustion problems related to a tank furnace.

At the meeting of the White Wares Division, a colloquium on feldspar will be held in which F. C. Flint is scheduled to speak on "Feldspar for Glass Makers."

Plant Visits

The visiting members will be divided into groups and four separate parties will make trips on Thursday, February 15, and three parties on Friday. No two parties will visit the same plants. This arrangement will permit each visiting member to select two out of seven entirely different trips.

Ladies are invited to accompany the groups taking trips designated below as Numbers 1, 3 and 5.

It will be necessary to secure passes for a number of the plants not later than Wednesday, February 14, and to let the plant managers know how many people will be in the parties. Therefore registration will close on Tuesday, February 13, at 6 o'clock. Each member is urged to register for trips as early as possible.

Outline of Trips

Trip No. 1. To Rochester and Beaver Falls; Thursday, February 15. F. W. Walker, Sr., in charge.

Plants to be visited:

1. H. C. Fry Glass Company, Rochester, Pa. Glass for all kinds of cooking utensils.
2. Fallston Fire Clay Co., Fallston, Pa. Face-brick.
3. Beaver Falls Art Tile Co., Beaver Falls, Pa. Manufacturers of white glaze tile.
4. Mayer China Co., Beaver Falls, Pa. Manufacturers of vitrified hotel china.

Trip No. 2. To Arnold, Glassmere and Springdale; Thursday, February 15. L. P. Forman and J. W. Cruikshank in charge.

Plants to be visited:

1. American Window Glass Co., Arnold, Pa.
2. Allegheny Plate Glass Co., Glassmere, Pa.
3. Heidenkamp Plate Glass Co., Springdale, Pa

Trip No. 3. City trip; Thursday, February 15. J. W. Cruikshank in charge.

Places to be visited:

1. Standard Sanitary Manufacturing Co., North Side, Pittsburgh, Pa.
2. Pittsburgh Clay Pot Co., North Side, Pittsburgh, Pa.
3. United States Glass Co., South Side, Pittsburgh, Pa.
4. The Willetts Co., South Side, Pittsburgh, Pa. Glass house refractories.
5. Woods-Lloyd Co., South Side, Pittsburgh, Pa. Glass house refractories.
6. Mellon Institute.
7. Glass and pottery exhibit, and Technologic Library, Carnegie Museum and Library.

Trip No. 4. To Clairton and Donora, Thursday, February 15. D. M. Buck in charge.

Plants to be visited

1. Clairton By-Product Coke Oven Plant of Carnegie Steel Co., Clairton, Pa. The largest by-product coke oven plant in the world.
2. Donora Steel Plant and Zinc Works of American Steel and Wire Co., Donora, Pa.

Trip No. 5. To East Liverpool, Ohio; Friday, February 16. F. K. Pence in charge.

Plants to be visited:

1. Homer Laughlin China Co., Newell, W. Va.
2. Golding and Son, Spar Grinders.
3. Plant No. 1, Hall China Co.
4. R. Thomas & Sons Co.

This trip will be of special interest to ladies as it includes plants making dinnerware and cooking china.

Trip No. 6. to McKeesport and Hayes, Friday, February 16. J. S. McDowell in charge, represented by Geo. R. Snyder.

Plants to be visited:

1. National Works, National Tube Co., McKeesport, Pa. This is the largest steel tube mill in the world.
2. Harbison-Walker Refractories Co., Hays, Pa. Silica and hand-made clay refractories.
3. By-Product Coke Oven Plant of Jones and Laughlin Steel Co., Hazelwood.

Trip No. 7. To East Pittsburgh, Universal and Derry, Friday, February 16. M. H. Hunt in charge.

Plants to be visited:

1. Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.
2. Universal Portland Cement Co., Universal, Pa.
3. Those who wish may omit the trip to Universal, and visit instead the plant of the High Voltage Insulator Co., Derry, Pa.

Verified News of Trade Activities

The Buck Glass Company, Baltimore, Md., recently increased its capital stock to $250,000.

The Nurre Mirror Plate Company, Bloomington, Ind., has increased its capital stock from $50,000 to $500,000.

The Patterson Glass Manufacturing Company, Cameron, W. Va., has increased its capital stock from $50,000 to $150,000.

The Hudson Glass Company, dealers in broken glass, has moved its office from Newark, N. J., to 150 Nassau street, New York.

The F. E. Reed Glass Company, Rochester, N. Y., manufacturers of all kinds of bottles, has increased its capital from $200,000 to $750,000.

The Lynch Glass Machinery Company, Anderson, Ind., recently increased its capital stock from $10,000 to $50,000, with an additional preferred stock of $100,000.

The Roessler & Hasslacher Chemical Company, 709 Sixth avenue, New York, manufacturers of chemicals, has filed notice of increase in capital from $1,300,000 to $3,250,000.

The Hart Glass Manufacturing Company, Dunkirk, Ind., has increased its capital stock from $300,000 to $500,000. The company manufactures a complete line of bottles and containers.

Joseph Volkommer of the **Vitro Manufacturing Company,** Pittsburgh, Pa., is interested in the construction of a new bottle factory for the Glass Bottle Company of Peru, near Lima, Peru.

The Atlantic Bottle Company, Tarentum, Pa., has let the contract for the rebuilding of its bottle plant, which was destroyed last summer, to the Pittsburgh Bridge Company, Pittsburgh, Pa.

The Gleason-Tiebout Glass Company, Brooklyn, N. Y., has increased its capital stock from $100,000 to $400,000, the $300,000 being transferred from surplus to capital stock in form of a stock dividend.

The Illinois Glass Company, Alton, Ill., operating plants at Alton, Gas City, Ind., Bridgeton and Minotola, N. J., has been incorporated with a capital stock of $11,100,000. George M. Levis is president of the company.

The Bohemian Glass Agency, New York, N. Y., has been incorporated with a capital of $5,000 by E. Goldberg, J. A. Pulpit and E. Charwat. A. S. Arronstaam, 63 Park Row, New York, is attorney for the new company.

Operations have been resumed at the new bottle and container factory of the **Scott-Warman Glass Company,** at Stroudsburg, Pa. The new factory, which takes the place of the one destroyed by fire last year, gives employment to about 125 hands.

The Newton Cut Glass Company, Bowling Green, O., will shortly move into the new quarters which have been provided for it by the Commercial Club of Bowling Green. A new department for decorating cut glass will be established by the company.

The Zenor Bottle Company, Fort Smith, Ark., has taken title to the former Crystal Glass Company, also located at Fort Smith and has begun operations successfully. The company reports that it has enough orders on hand to enable it to run for a year.

The Standard Plate Glass Company, Butler, Pa., announces that a special meeting of the stockholders of the company will be held at its offices on February 21, 1923,, for the purpose of voting for or against the proposed increase of capital stock from $1,500,000 to $3,000,000.

The National Glass Company, Inc., Bridgeport, Conn., has been incorporated with a capital of $50,000 by Harry Schwartz, Mitchell Stone, and Max Cohen. The company will deal in glass products, mirrors, etc., and will operate a mirror polishing and beveling plant.

The Kearns-Gorsuch Glass Company, Zanesville, O., announces that the construction of its new plant is completed and that operation was started on January 8th, with satisfactory results. This company is a subsidiary of the Hazel-Atlas Glass Company of Wheeling, W. Va.

The Kiefer Bros. Products Corporation, Brooklyn, N. Y., has been incorporated with a capital of $50,000 by A. Cohen and S. Alpert, to manufacture machinery for making cut glass. The company reports that it will use the first machine which it manufactures for its own production.

The West Virginia Glass Company, Huntington, W. Va., manufacturer of glass jars, contemplate the construction of an addition to its plant which, when completed, will give employment to about a hundred additional men and which will be used for making a steel cap with glass enclosed for glass jars.

The Madeira Crystal Glass Works, with executive offices at Chicago, Ill., has been organized to take over the old Allen Cut Glass Works at Johnstown, Pa. The officers of the company are: John F. Hubbs, president; Edward G. Schuettge, vice-president and treasurer, and Harry E. Demarais, secretary.

The Libbey Glass Manufacturing Company states that published reports regarding the sale of property belonging to the company in Toledo, O., are misleading. The sale referred to involved holdings outside of Toledo and in no way affected the properties of the Libbey Glass Manufacturing Company in that city.

John C. Wiarda & Company, Brooklyn, N. Y., manufacturers of chemicals for glass makers, etc., has increased its capital stock from $40,000 to $115,000. Howard B. Bishop, president of the company, reports that this has become necessary in order to take care of increasing business and to provide for future extension.

The Buckeye Glass Company of Toledo, Ohio, has a large force of men at work getting their plant into shape to begin operation shortly. The company is starting with complete automatic glass blowing machines and will manufacture a general line of flint, bottles and jars. David Pugh is general manager, and business is reported to look very promising for the future.

The Sterling Glass Company's plant at Lapel, Ind., is being put in shape to resume glass making and according to Arthur Woodward, manager, will be equipped with Lynch LA machines and Miller feeders for making narrow neck ware such as extract bottles, castor oil flasks, sauce, vinegar and patent medicine bottles and also polish bottles in narrow and semi-wide mouth varieties.

The Silica Glass Sand Company, of Sturgisson, W. Va., has increased its capital from $100,000, to $125,000 to provide additional working capital and to allow for the installation of a dryer to enable the company to produce No. 1 dry white glass sand. The plant, with the exception of the dryer, is completed and the company is now beginning to manufacture a high grade silica sand for glass melting and grinding.

The Ruth Glass Company, Conshohocken, Pa., has placed orders for additional machinery and it is planned to operate the plant night and day in order to double production and take care of increasing orders. The Company has also had men working on it's glass tubing mill which has not been operating since it was damaged by fire several years ago. It is expected that this mill will be ready for operation early in February.

The Koeppen Mould Works, manufacturers of hand and machine molds for glass containers, Marion, Ind., has increased its capital stock from $15,000 to $30,000. The facilities and equipment of the company at the present time are such that its output has been greatly increased. This company, which was established in 1891 now has over 14,000 sq. ft. of floor space, devoted exclusively to making hand and machine molds for glass containers.

The Keller Mechanical Engineering Corporation, 70 Washington street, Brooklyn, N. Y., has been organized to succeed the Keller Mechanical Engraving Company, with an authorized capital of $550,000. The management of the company will remain the same. The change in the name was made because it was found that the word "Engraving" was misleading, the new name better fitting the activities of the corporation which include the building of die sinking and mold cutting machines and the production of dies and molds. Machines for cutting molds for bottles and other glassware made by this company are in use in various factories.

An alliance between **Bausch & Lomb Optical Company,** Rochester, N. Y., and Stevens & Company, Inc., Providence, R. I., has been formed for the purpose of developing the products of both organizations, toward a complete line of optical merchandise. It is intended that the same high standard of quality which has always characterized the products of the two companies, will not only be maintained, but through the co-operation of both scientific and technical staffs, enhanced wherever possible. Both companies will continue to function as separate organizations, with their respective business policies unchanged.

The Paterson Glass Company, Henryetta, Okla., was recently organized by W. H. Welp, president; J. R. Nicholson, vice-president; Joe Kenigseder, secretary, and A. F. Paterson, general manager and treasurer. The company has acquired the plant of the Henryetta Glass Manufacturing Company and for the present will manufacture lamp chimneys, but expects later to make punch tumblers, electric globes, etc., and has purchased machinery for that purpose from A. B. Knight, Fairmont, W. Va. The company announces that it is ready to receive equipment catalogs of all kinds and is also in the market for raw material.

Trade Publications

Crain's Market Data Book and Directory of Class, Trade and Technical Publications. Second edition. 456 pages. Published by C. D. Crain, Jr., Chicago, Ill. $5.00. Presents statistical and marketing data regarding many different industries for the purpose of giving the manufacturer or merchandiser a picture of the industrial and commercial field as a whole, and a general idea of the advertising and sales possibilities in each part of the field. Several pages are devoted to glass and other ceramics.

Hendricks' Commercial Register of the United States 31st (1923) annual edition; 2,482 pages, 8½ in. x 11½ in. Price $15.00. S. E. Hendricks Co., Inc., 70 Fifth avenue, New York.

The 1923 edition of this well-known and useful Register contains 150 pages over and above the 1922 edition; 125,000 changes and additions were made to the new edition. The lists cover the electrical, engineering, machinery, building, manufacturing, chemical and other industries, together with all industries allied thereto. The lists are intended for the use of both buyers and sellers. Over 18,000 products are separately classified with the name and address of manufacturers or producers. All the manufacturers and others included in the Register, besides being listed under all the products they handle, are also arranged in one alphabetical section according to name. All brands, trade names and such like are arranged by name in one alphabetical list with the name and address of the manufacturer following.

Chemical Engineering Catalog, 1922, seventh annual edition. Published by the Chemical Catalog Company, Inc., New York. 1187 pages. 8½ by 11½ inches. The book is leased to chemists, engineers, managers, superintendents and others associated with chemical industries for $2.00 a year. To others, the price is $10.00.

The new edition of this valuable and widely used directory maintains the high standard of excellence set by the earlier editions. It contains a general directory, occupying 214 pages, of manufacturers of chemicals, raw materials and equipment used in the industries employing chemical processes. Devoted to descriptions and condensed and standardized catalogs of manufacturers' equipment and materials is a section of 849 pages, more than four times the space occupied by this section in the first edition published in 1916.

The Chemical Engineering Catalog is compiled and published under the supervision of an official committee appointed by the American Institute of Chemical Engineers, the American Chemical Society, and the Society of Chemical Industry, a sufficient guarantee as to the authenticity and character of the work.

Deaths

William Campbell King

William Campbell King, 83 years old, a pioneer in the glass manufacturing business in Pittsburgh, Pa., died on January 23rd at his home in that city. Mr. King entered the glass manufacturing industry with his father, operating under the name of D. C. King & Company until 1891. In that year a merger was formed with other glass companies and the United States Glass Company resulted, of which Mr. King was secretary and treasurer until 1906, when he retired.

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

PITTSBURGH STOCK EXCHANGE, JANUARY 26, 1923.

	Bid	Ask	Last
American Window Glass Machine, com...	80	81	80
American Window Glass Machine, pfd....	90	93	93
American Window Glass Preferred.....	108	...	108
Pittsburgh Plate Glass.....	202	203	203
U. S. Glass (new stock).....	...	25	26

Throughout the month the market for the glass stocks has been characterized by a quiet tone. Recent reports state that all of the glass concerns are showing very satisfactory earnings, while Pittsburgh Plate Glass is believed to be earning at the highest rate in its history. During the month Pittsburgh Plate Glass stock sold at its highest price. The new stock of U. S. Glass was inactive and maintained an even price level with relatively few trades.

WHEELING STOCK EXCHANGE, JANUARY 26, 1923.

	Bid	Ask	Last
Hazel-Atlas	158½	159	158½
Imperial Glass	99½	105	99½
Fostoria Glass	125	...	125
Central Glass	95	100	100

The Wheeling Glass stock market was a little more active during last month than it has been for some time in the past. Recently Imperial held its annual meeting and re-elected the old board. At that time it was announced earnings were very satisfactory and showing an increasing tendency. Announcement was recently made that the Jefferson Glass Company would shortly place on the market a new issue of 7 per cent. preferred stock, which will be listed on the Wheeling Stock Exchange in the near future. This company was established in 1912 and manufactures mainly illuminating ware, railroad lights and automobile lenses. The company has outstanding a small bond issue and figuring earnings over a period of the last ten years, they have run at a rate equal to 2½ times the dividend requirements of the preferred stock after the payment of interest charges on the funded debt.

TOLEDO STOCK EXCHANGE, JANUARY 26, 1923.

	Bid	Ask	Last
Owens Bottle common.....	44½	...	44⅜
Owens Bottle preferred.....	108	110	...
Libbey-Owens Sheet Glass common.....	120	125	...
Libbey-Owens Sheet Glass preferred.....	...	108	...

Inquiries Received

For further information address THE GLASS INDUSTRY

106.—We would like to be informed as to where we can get pressed glass blanks, sizes 2½ by 7 and 4 15/16 inch round. Would also like to know the names of concerns who can grind these blanks for us to 25 and 50 minus.

107.—We would like the address of a glass factory that can furnish a 1½ ounce glass container for a hotel line of jams and jellies.

108.—Could you tell us where we could obtain the necessary machinery for beveling glass?

109.—(From South America). I desire to be put in touch with manufacturers of tank furnaces to be operated by oil for colorless glass and bottles. I am also interested in machines for the manufacture of clock glasses of all sizes, demijohns up to 10 and 12 litres, machines for drawing glass drainage tubes of ⅜ inch diameter and for the manufacture of all sizes of flasks.

110.—Can you advise us from whom we can purchase glass slag of a black and green color? We understand that certain glass manufacturers have this waste material which is now being sold to be ground up and to be used in cement finish.

111.—Will you kindly advise where we can obtain French fatty oil of turpentine that is used for stamping monograms, etc., on to glass ware. We understand that this material is mixed with a fusible enamel powder and used as a vehicle in preparing enamel pastes.

112.—(From England). Can you furnish us with the names of companies making machinery for the manufacture of the cheaper grade of optical lenses?

113.—Can you give us the names of concerns that make flashed glass in various colors?

114.—We would like to receive catalogs of glass factory equipment of all kinds and are in the market for raw materials.

Current Prices of Glass-Making Materials

From quotations furnished by various manufacturers and dealers

January 26, 1923

	Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)..lb.	.05	.05½
Aluminum oxide (Al_2O_3).....lb.	.05½	.06½-.07
Antimony oxide (Sb_2O_3).. ...lb.	.07	.07½
Arsenic trioxide (dense white), 99% (As_2O_3).....lb.	.15	.16
Barium carbonate ($BaCO_3$)...ton	70.00	90.00
Barium hydrate ($Ba(OH)_2$)....lb.	.05½	.05¾
Bone ash .....lb.	.05	.06
Borax ($Na_2B_4O_7 10H_2O$) .....lb.	.05½	.06
Borax, fused, any mesh ($Na_2B_4O_7$) .....lb.	.19	.20
Boric acid, fused (B_2O_3).....lb.	.35	.35
Cadmium Sulphide, red (CdS)..lb.	..	1.65
Cadmium Sulphide, orange.....lb.	..	1.65
Cadmium Sulphide, yellow (CdS) .....lb.	..	1.90
Chrome oxide .....lb.	.35	.36
Cobalt oxide, in bbls. (Co_2O_3)...lb.	..	2.25
Cobalt oxide, in 10 lb. tins (Co_2O_3) .....lb	..	2.20
Copper oxide, red .....lb.	..	.15-.16
Copper oxide, black (CuO).....lb.	..	.26
Copper oxide, black prep'd (CuO) .....lb.	..	.30
Cryolite (Na_3AlF_6) .....lb.	..	.09½
Feldspar, 100 mesh.....ton	15.00	25.00
Fluorspar, powdered white, 95% (CaF_2) .....ton	35.00	45.00
Fluorspar, powdered white, 90% (CaF_2) .....ton	33.00	38.00
Hydrofluoric acid (HF) 60%..lb.	.14	..
Kaolin .....ton	17.00	25.00
Lead oxide (red lead) (Pb_3O_4)..lb.	.11¼	.11½
Litharge (PbO) .....lb.	.10¾	.11
Lime—		
Hydrated (in 50 lb. paper sacks) ($Ca(OH)_2$) .....ton	11.50	..
Burnt, ground, in bulk (CaO).ton	8.00	..
Burnt, ground, in paper sacks.ton	10.00	..
Burnt, ground in 280 lb. bbls. per bbl.	2.10	2.25
Manganese 85% (MnO_2).....lb.	.03¾	.04¼-.06
Nickel oxide, black (Ni_2O_3) for nickel content .....lb.	..	.50
Nickel monoxide, green (NiO) for nickel content.....lb.	..	.50
Potassium carbonate—		
Calcined 90% (K_2CO_3).....lb.	.06¼	.06½
Hydrated 90% (KOH) .....lb.	.07	.07¾
Potassium nitrate (KNO_3) (gran.) .....lb.	.06½	.06¾
Powdered blue .....lb.	..	.26-.30
Powdered blue (std. formula)..lb.	..	.38
Salt cake, glassmakers, f. o. b. works (Na_2SO_4) .....ton	21.00	per lb. .01½-.02
Selenium (Se) .....lb.	..	1.95.-2.25
Soda ash, 58% dense, 48% basis Bulk (Na_2CO_3) .....100 lb.	1.22½	..
Bulk, on contract (Na_2CO_3) 100 lb.	1.17½	..
Sodium nitrate, refined ($NaNO_3$).lb.	..	.04¾-.06¼
Sodium selenite (Na_2SeO_3).....lb.	..	2.00-2.15
Sodium Fluosilicate (Na_2SiF_6)...lb.	.07¾	.08
Sulphur (S) (flowers)—in bbls. per 100 lb.	3.25	3.55–3.80
Sulphur (flowers) Bags per 100 lb.	3.00	3.30–3.55
Sulphur (S) (flour, heavy), in bbls. per 100 lb.	2.50	3.00
Uranium oxide—100 lb. lots (UO_3) .....lb.	..	2.25-2.50
Zinc oxide (ZnO) .....lb.	.07½	.08

Monthly Summary of United States Foreign Commerce in Glass

Corrected to January 3, 1923

[NOTE: Only the exports of domestic merchandise by articles and principal countries are published at this time, on account of continued delay in the import reports. The corresponding statement of imports will be published when the delayed reports are received.]

EXPORTS

	November 1921		November 1922		Eleven Months Ending November 1921		Eleven Months Ending November 1922	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Glass and glass products (total).....	.....	699,218	.....	704,174	.....	13,558,394	.....	7,771,480
Window glass, common, box, 50 sq. ft.....	822	5,809	1,855	12,138	56,706	447,573	30,651	165,705
Plate glass, unsilvered, sq. ft.....	159,027	73,737	219,663	67,244	2,086,742	1,248,675	2,427,800	1,014,694
Wire glass, sq. ft.....	.....	.....	7,616	1,988	.....	.....	214,732	57,435
Other window and plate glass, n. e. s.....lbs.	.....	.....	174,024	14,486	.....	.....	1,798,143	202,011
Glass containers (bottles, vials and jars).....lbs.	.....	181,652	3,451,714	195,970	.....	4,342,756	37,927,352	2,073,669
Table glassware, plain.....lbs.	.....	.....	1,354,538	143,759	.....	.....	11,673,679	1,284,057
Table and other glassware, cut or engraved....lbs.	.....	9,470	51,561	20,897	.....	170,260	419,245	158,057
Glassware for lighting—								
Lamp chimneys and lantern globes.....lbs.	.....	.....	123,080	19,805	.....	.....	1,285,932	257,683
Globes and shades for lighting fixtures.....lbs.	.....	.....	194,460	41,065	.....	.....	1,421,185	395,251
Lamps and other illuminating devices, chiefly of glass .....lbs.	.....	.....	102,238	33,450	.....	.....	1,000,998	351,608
Chemical glassware .....lbs.	.....	12,692	16,431	11,767	.....	215,294	254,276	141,656
Electrical glassware, except for lighting.....lbs.	.....	.....	120,016	7,828	.....	.....	1,955,898	147,863
Other glassware, n. e. s.....lbs.	.....	415,858	965,809	133,777	.....	7,133,836	11,770,812	1,521,791